

Claims Listing

1. (Currently Amended) A method of controlling a biological wastewater treatment process, comprising:

A. in at least one treatment tank containing wastewater and having associated therewith at least one device to supply an increasing and decreasing flow of oxygen-containing gas and/or wastewater into the tank, conducting a biological process wherein the need for oxygen in the process repeatedly increases and decreases during the process.

B. supporting the process supported, at least in part [[,]] by introducing the oxygen-containing gas into the wastewater in the form of bubbles provided in the wastewater by a gas supply system, and causing at least a portion of the oxygen in the [[said]] bubbles to dissolve in the wastewater and at least a portion of the dissolved oxygen to be consumed by the biological process

1. wherein the oxygen so dissolved may represent an excess or a deficiency relative to the oxygen consumed by the biological process, and

17 2. wherein at least one gas collection member is positioned in
18 ~~the treatment tank~~ to receive offgas representing gas from said
19 bubbles that has not been dissolved into the wastewater;

20 ~~[[B.]]~~ C. controlling the operation of the biological process with a control
21 system that, as the process operates, exercises continuing control
22 over the process at least partially in response to

23 1. offgas measurements~~[[,]]~~ that are taken by the control
24 system from the offgas collected in the gas collection member
25 and that are correlative with changing amounts ~~the amount~~ of
26 one or more gases in the offgas~~[[;]]~~ and

27 2. DO data correlative with varying DO levels in the
28 wastewater and/or performance data correlative with varying
29 ability of the gas supply system to transfer oxygen to the
30 wastewater

31 ~~[[C.]]~~ D. utilizing said measurements and data obtained through said
32 measurements to provide, in the control system, ~~for the varying~~
33 ~~amounts of consumption of oxygen that occur in the biological~~
34 ~~process~~, control values, ~~[[or]]~~ which may be components of control

35 values, ~~that change in response to, while remaining correlative with,~~
36 ~~such varying amounts of oxygen consumption, and generating~~
37 ~~control signals based on the changing control values or components~~
38 and which include

39 1. first control values, comprising requirements control values,
40 that change in response to, while remaining correlative with,
41 the need for oxygen in the process, and

42 2. second control values, comprising DO control values and/or
43 performance control values that change in response to, while
44 remaining correlative with, respectively, DO levels in the
45 wastewater and/or the varying ability of the gas supply system
46 to transfer oxygen to the wastewater; and

47 E. deriving, in the control system, utilizing said first and second
48 control values, control signals for adjusting said at least one device.

1 2. (Currently Amended) A method of controlling a wastewater treatment
2 process, comprising: according to claim 1 wherein the control system

3 ~~A. in at least one treatment tank containing wastewater, conducting~~
4 ~~a biological process comprising suspended growth aeration in which~~
5 ~~biological breakdown of suspended and/or dissolved waste material~~
6 ~~present in the wastewater is supported, at least in part, by~~
7 ~~introducing oxygen-containing gas into the wastewater in the form of~~
8 ~~bubbles provided in the wastewater by a gas supply system, which~~
9 ~~bubbles rise through at least a portion of the depth of the wastewater~~
10 ~~in the direction of its upper surface, and causing at least a portion of~~
11 ~~the oxygen in said bubbles to dissolve in the wastewater and at least~~
12 ~~a portion of the dissolved oxygen to be consumed by the biological~~
13 ~~process~~

14 ~~1. wherein the oxygen so dissolved may comprise an excess~~
15 ~~or represent a deficiency relative to the oxygen consumed by~~
16 ~~the biological process, and~~

17 ~~2. wherein at least one gas collection member is positioned to~~
18 ~~receive offgas representing gas from said bubbles that has not~~
19 ~~been dissolve[[e]]d into the wastewater;~~

~~B. controlling the operation of the process with a control system that, as the process operates, exercises continuing control over the introduction of wastewater into the process and/or over the quantity amount of gas discharged into the tank and repeatedly increases and decreases that amount, during the process, as the need for oxygen varies, and the control signals derived in the control system are based at least in part on offgas measurements, DO data and performance data and are utilized to control the amount of gas discharged into the tank through said gas supply system, at least partially in response to measurements of the offgas, taken by the control system, that are correlative with the amount of one or more gases in the offgas; and~~

~~C. utilizing data obtained through said measurements to provide, in the control system, control values which are at least in part correlative with changing needs for the supply of dissolved oxygen to the wastewater as determined by the control system at least partly on the basis of such data.~~

3. (Currently Amended) A control Control system apparatus for controlling a biological wastewater treatment process, comprising

3 apparatus that comprises at least one tank to contain and treat wastewater
4 in a biological process, at least one device to supply an increasing and
5 decreasing flow of an oxygen-containing gas into the wastewater to
6 support the process, a gas supply system to introduce the gas into the
7 wastewater as bubbles and cause at least a portion of the oxygen in the
8 bubbles to dissolve in the wastewater and be at least partly consumed by
9 the process and [[A.]] at least one gas collection member[[,.]] positioned in
10 ~~at least one wastewater processing tank in which the biological process is~~
11 ~~conducted, to collect from the wastewater in the processing tank, to~~
12 receive ~~offgas representing at least a portion of oxygen-containing gas that~~
13 ~~has been introduced into but not dissolved in~~ from ~~the wastewater, said~~
14 control system comprising the combination of:

15 [[B.]] A. ~~at least one measuring device comprising at least one gas~~
16 ~~detector that is connected with the gas collection member and that~~
17 ~~can take~~ offgas ~~measurements and thereby provide data indicative of~~
18 ~~the amount~~ correlative with varying amounts ~~of at least one gas in the~~
19 ~~offgas collected in~~ in [[by]] ~~the gas collection member, [[and]]~~

20 B. at least one DO (dissolved oxygen) detector that, when in
21 contact with the wastewater in the tank, can take DO measurements
22 of the DO levels of the wastewater, and

23 C. at least one controller

24 ~~1. which is connected with the measuring device, which~~
25 ~~defines, for the varying amounts of consumption of oxygen that~~
26 ~~occur in the biological process, control values, or components~~
27 ~~of control values, that change in response to, while remaining~~
28 ~~correlative with, such varying amounts of oxygen consumption,~~
29 ~~which controller generates control signals based on the control~~
30 ~~values or components~~ contains or has access to code which
31 the controller can utilize with the offgas measurements and DO
32 measurements to provide, in the control system, varying control
33 values, which may be components of control values, that are

34 a. at least in part correlative with repeatedly fluctuating
35 requirements for oxygen-containing gas flow to support
36 the biological process and

37 b. at least in part correlative with such varying positive or
38 negative adjustment of the oxygen-containing gas flow as
39 may be needed to cause the wastewater DO levels to
40 move toward, return to or be maintained at a target value,
41 and

42 2. which derives control signals, based at least in part on said
43 control values, to which the at least one device is responsive.

1 4. (Currently Amended) A control system according to claim 3 wherein
2 the at least one controller contains or has access to additional code which
3 the controller can utilize with performance data to provide, in the control
4 system, varying additional control values, which may be components of
5 control values, correlative with the varying ability of the gas supply system
6 to transfer oxygen to the wastewater, and wherein the additional code is
7 configured to apply the additional control values in combination with the
8 first-mentioned control values in deriving the control signals for controlling
9 ~~wastewater treatment apparatus of the type that comprises at least one~~
10 ~~tank for conducting a biological process comprising suspended growth~~
11 ~~aeration on wastewater, a gas supply system for introducing oxygen-~~
12 ~~containing gas into the wastewater in the form of bubbles and causing at~~
13 ~~least a portion of the oxygen in said bubbles to dissolve in the wastewater~~
14 ~~and at least a portion of the dissolved oxygen to be consumed by the~~
15 ~~biological process, wherein the oxygen so dissolved may comprise an~~
16 ~~excess or represent a deficiency relative to the oxygen consumed by the~~
17 ~~biological process, and wherein at least one gas collection member is~~
18 ~~positioned to receive offgas representing gas from bubbles that have not~~

18 ~~representing gas from bubbles that have not been not dissolve[[e]]d into~~
19 ~~the wastewater; said control system comprising:~~

20 ~~— A. at least one gas detector that can take measurements of the~~
21 ~~amount of at least one gas collected in the gas collection member;~~

22 ~~— B. at least one DO (dissolved oxygen) detector having a probe that,~~
23 ~~when in contact with the wastewater in the tank, can take~~
24 ~~measurements of the DO level of the wastewater, and~~

25 ~~— C. at least one controller containing or having access to code which~~
26 ~~the controller can utilize with said measurements to provide, in the~~
27 ~~control system, control values which are at least in part correlative~~
28 ~~with changing needs for the supply of dissolved oxygen to the~~
29 ~~wastewater.~~